

CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

1 1. An ultrasound-imaging system, comprising:
2 means for identifying the impulse response of a transmit channel of the
3 ultrasound-imaging system;
4 means for selecting a desired transmit channel signal spectrum, the transmit
5 channel signal spectrum defined by an envelope and a transmit center frequency;
6 means for determining an excitation signal that when applied in the transmit
7 channel produces the selected transmit channel signal spectrum;
8 means for applying the excitation signal;
9 means for receiving a reflected excitation signal centered about a harmonic of
10 the transmit center frequency;
11 means for selecting a desired receive channel filter function to apply to the
12 reflected excitation signal;
13 means for identifying the impulse response of a receive channel of the
14 ultrasound-imaging system; and
15 means for formulating a receive channel filter responsive to the desired filter
16 function and the receive channel impulse response.

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1 2. The system of claim 1, wherein the means for selecting a desired
2 transmit channel signal spectrum identifies a desired transmit channel signal spectrum
3 reflective of a symmetric function.

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1 3. The system of claim 2, wherein the symmetric function comprises a
2 Gaussian function.

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1 4. The system of claim 1, wherein the means for identifying the impulse
2 response of a transmit channel determines the impulse response by measurement.

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1 5. The system of claim 1, wherein the means for identifying the impulse
2 response of a transmit channel determines the impulse response by calculation.

1 6. The system of claim 1, wherein the determining means formulates the
2 excitation signal as a function of the impulse response and the desired transmit
3 spectrum.

1 7. The system of claim 6, wherein the formulated excitation signal
2 comprises calculating an inverse Fourier transform.

1 8. The system of claim 6, wherein the formulation comprises performing
2 a deconvolution operation.

1 9. The system of claim 8, wherein the deconvolution operation uses a
2 Weiner filter.

1 10. The system of claim 8, wherein the deconvolution operation uses
2 polynomial time division.

1 11. An ultrasound-imaging system, comprising:
2 means for identifying the impulse response of a receive channel of the
3 ultrasound-imaging system;
4 means for selecting a desired receive channel filter function, wherein the
5 receive channel processes a harmonic echo of ultrasound energy transmitted by the
6 ultrasound-imaging system; and
7 means for formulating a receive channel filter responsive to the desired filter
8 function and the receive channel impulse response.

1 12. The system of claim 11, wherein the means for selecting identifies a
2 desired receive channel filter that when applied to ultrasound echoes results in a
3 receive signal that can be modeled with a symmetric function.

1 13. The system of claim 12, wherein the symmetric function comprises a
2 Gaussian function.

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1 14. The system of claim 11, wherein the means for selecting identifies a
2 desired receive channel filter function with a center frequency at a harmonic multiple
3 of a fundamental frequency of an excitation signal.

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1 15. The system of claim 11, wherein the means for identifying determines
2 the impulse response by measurement.

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1 16. The system of claim 11, wherein the means for identifying determines
2 the impulse response by calculation.

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1 17. The system of claim 11, wherein the means for determining formulates
2 a receive filter as a function of the impulse response of the receive channel and the
3 desired receive channel filter function.

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1 18. The system of claim 17, wherein the formulation comprises calculating
2 an inverse Fourier transform.

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1 19. The system of claim 17, wherein the formulation comprises performing
2 a deconvolution operation.

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1 20. The system of claim 19, wherein the deconvolution operation uses a
2 Weiner filter.

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1 21. The system of claim 19, wherein the deconvolution operation uses
2 polynomial time division.

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1 22. An improved ultrasound-imaging system, comprising:
 2 a transducer;
 3 a switch coupled to the transducer, wherein the switch is positioned to apply
 4 an excitation signal to the transducer in a transmit mode of the ultrasound-imaging
 5 system, the excitation signal having a center frequency;
 6 a signal shaper coupled to the switch, the signal shaper configured to generate
 7 the excitation signal, the signal shaper further configured to adjust the excitation
 8 signal in response to the impulse response of the transmit channel such that a desired
 9 ultrasound energy waveform is generated by the transducer; and
 10 a receive channel signal shaper coupled to the transducer, the receive channel
 11 signal shaper comprising a filter, the filter formulated in response to the receive
 12 channel impulse response and a desired echo response signal spectrum, the filter
 13 further configured to process the ultrasound echo response at a harmonic of the center
 14 frequency.

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 1 23. The system of claim 22, wherein the transducer has a passband capable
 2 of harmonic imaging.

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 1 24. The system of claim 22, wherein the desired ultrasound energy
 2 waveform generated by the transducer can be modeled with a symmetric function
 3 centered at a fundamental frequency.

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 1 25. The system of claim 22, wherein the echo response signal spectrum is
 2 centered about at least one harmonic multiple of the fundamental frequency of the
 3 excitation signal transmitted via the transducer.

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1 26. A method for enhancing the axial resolution and improving transducer
2 response sensitivity in an ultrasound-imaging system, comprising the steps of:
3 selecting a desired transmit spectrum;
4 quantifying the transmit channel impulse response;
5 calculating a drive signal that when applied to the transmit channel will
6 produce the desired transmit spectrum, the drive signal having a center frequency;
7 applying the drive signal to a transducer;
8 selecting a desired echo response spectrum;
9 quantifying a receive channel impulse response;
10 deriving a filter that when applied to received ultrasound echo signals will
11 produce the desired echo response spectrum at a harmonic of the center frequency;
12 and
13 applying the filter to the received ultrasound echo signals.

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1 27. The method of claim 26, wherein the transducer has a passband
2 capable of harmonic imaging.

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1 28. The method of claim 26, wherein the desired transmit spectrum
2 generated by the transducer can be modeled with a symmetric function centered at a
3 fundamental frequency of the drive signal.

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1 29. The system of claim 27, wherein the received ultrasound echo signals
2 are centered about at least one harmonic multiple of the fundamental frequency of the
3 drive signal transmitted via the transducer.